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USE OF MODERN DOMESTICALLY PRODUCED EQUIPMENT IN GLASSMAKING PRACTICE

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Positive experience in using modern Russian equipment — series LMO magnetic separators for quartz sand and a specialized magnetic holder for glass-molds for the production of glass containers — at the "Smerdomskii steklozavod," is described. It is shown that the use of magnetic enrichment of quartz sand from a local deposit has a positive effect on the technological processes of glassmaking, and the use of specialized magnetic holder for glass-molds increases the repair quality and decreases repair time for glass-molds.

Key words: magnetic separator, quartz sand, magnetic enrichment, glassmaking, glass container production, magnetic holder of glass-molds.

At Russian enterprises any improvements achieved by altering the production process are usually made by purchasing and mastering high-capacity imported equipment.

However, modern domestically produced equipment also makes it possible not only to save money but also to obtain results equivalent in terms of effectiveness and in some cases not attainable with the use of imported equipment.

We shall examine two examples from practice at the "Smerdomskii steklozavod" JSC.

Example 1. Stabilization of the iron oxide content in glass batch at the "Smerdomskii steklozavod" JSC by means of magnetic enrichment of quartz sand.

The negative effect of an elevated content of iron oxide and the fluctuations of the iron oxide content in glass batch on the overall yield and quality of the yearly production is well known. It is evident that sand from local deposits makes it possible to lower the final production costs of colored container glass. As a rule, to obtain high-quality products it is necessary to lower and stabilize the content of iron oxide in the main component of the glass batch — quartz sand from a local deposit. An accessible method of lowering and stabilizing iron oxide in glass sand is magnetic enrichment.

Quart sand from the Sazonovskii deposit (Chagodoshchenskii rayon of Vologodskaya Oblast') is used at the "Smerdomskii steklozavod" JSC for glass production.

To improve the quality of the articles produced at the "Smerdomskii steklozavod" JSC it was necessary to lower and stabilize the content of iron oxide in the quartz sand used at the level 0.4 – 0.55% (with initial fluctuation 0.8 – 1.2%) by means of magnetic separation of hot sand ($t \approx 100 – 150$°C) after it is dried. The operation of the magnetic separator must be stable in the presence of high dust contamination of the section where glass batch is prepared and the separator must provide stable results for magnetic enrichment with the expected high yield of tailings from magnetic separation (to 15%).

Specialists at the "Smerdomskii steklozavod" JSC performed a technical-economic analysis of the existing designs of magnetic separators, used for magnetic enrichment of quartz sand. The results of the analysis are largely identical to those of [1]. Specifically, it was determined that electromagnetic drum magnetic separators manufactured by "UGMK-Rudgormash" JSC (Voronezh, Russia) require large expenditures on the content and their operation is unstable when large quantities of tailings from magnetic separation are present. In addition, two-stage conveyer roller separators based on permanent magnets manufactured by Scientific – Industrial Firm (SIF) "Prodékologiya" (Rovno, Ukraine) and SIF "ÉRGA" (Kaluga, Russia) are only weakly adapted for operation under the dusty conditions of the sectional shop at the "Smerdomskii steklozavod." This is because the magnetic fraction of the dust, expected on the surface of the magnetic rollers of the separator, accelerates belt wear and the contamination of the surface of the magnetic rollers, which greatly degrade the results of magnetic enrichment. To eliminate the "dust coat" on the rollers or replace the belt the separator must be partially disassembled, the belt must be removed, and the surface of the roller carefully cleaned. Re-

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placing the belt or cleaning a roller is a laborious process. The lack of water cooling makes it difficult to use belt roller separators for magnetic enrichment of hot quartz sand.

Thus, the best magnetic separator design for solving the problem posed was needed. The choice was the LMO series single-stage magnetic drum separators, manufactured by the ITT Group, with a high-intensity magnetic system with permanent magnets [1 – 3]. Comparing the results of the experimental magnetic enrichment of quartz sand from the Sazonovskoe deposit of glass sands showed that with respect to separation quality the LMO series laboratory drum magnetic separator with a high-intensity magnetic system based on permanent magnets surpasses the laboratory belt roller separator, based on permanent magnets, manufactured by SIF "ÉRGA" (Kaluga). At the same time the design of the series LMO drum magnetic separators with a high-intensity magnetic system is compact, simple, and reliable, which has been confirmed by the operation of separators of this type at ore-enrichment works and glass plants [2, 3]. LMO series drum separators have a water-cooled magnetic system and are intended for magnetic enrichment of hot quartz sand. There is no need to observe the operation of the separators. The LMO series separators do not have any of the drawbacks which are characteristic of electromagnetic and belt roller separators. No foreign analogues of LMO series magnetic separators have been found.

Practice confirms the correctness of the choice of the magnetic separators and the orientation of the glassmaking technology at "Smerdomskii steklozavod" toward using glass batch with reduced and time-stabilized iron oxide content. Four LMO-5000-2, 2003 single-stage magnetic separators each with capacity 5 tons/h were purchased from 2005 to 2008. The mass of one separator is 700 kg with electric power requirement 2.2 kW and dimensions 1700 × 890 × 740 mm. Every LMO-5000-2, 2003 separator is equipped with a feeder and two magnetic drums with two water-cooled high-intensity magnetic systems. In an agreement made with the representatives of the manufacturers of the magnetic separators "Smerdomskii steklozavod" JSC specialists designed and built the enrichment section, equipped with platforms for sieving facilities and magnetic separators, conveyors, pipelines for feeding quartz sand, and conveyers for removing impurities and enriched sand. At the same time, to increase the capacity of the sectional shop the drying drum was replaced with a Russian-made AF-20 pressurized spout dryer.

Thus, the total power of the magnetic enrichment of quartz sand section was 20 tons/h. The LMO-5000-2, 2003 magnetic separator in the quartz sand magnetic enrichment section of the "Smerdomskii steklozavod" JSC is shown in Fig. 1. The two 1.1 kW electric motors located on the right-hand side of the separator rotate the right- and left-hand drums. The quartz sand is fed after it is dried and sieved from above through a pipeline and the common feed of the right- and left-hand drums. The products of enrichment are diverted through three pipelines, along two of which the enriched quartz sand enters the enriched-sand conveyer and the enrichment tailings are removed along the third pipeline. The experience gained over many years of operating the LMO-5000-2, 2003 magnetic separators for magnetic enrichment of pre-dried quartz sand with temperature to 150°C showed the following:

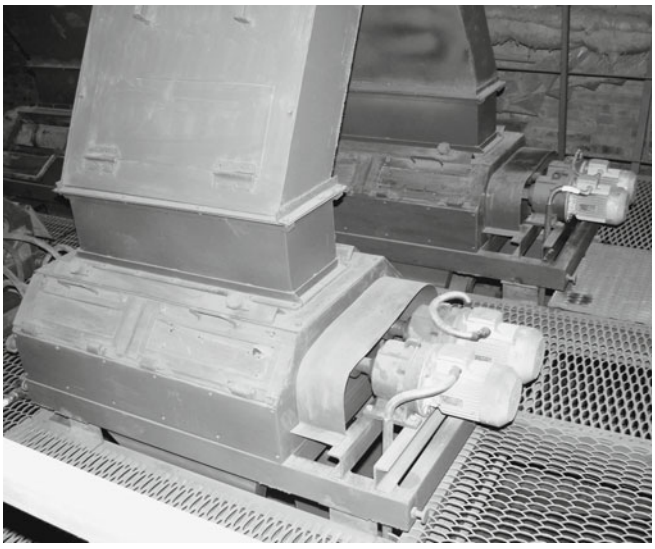

Fig. 1. LMO-5000-2, 2003 magnetic separator on the section performing magnetic enrichment of quartz sand at the "Smerdomskii steklozavod" JSC.

Iron oxide content, wt.%:	
in the initial quartz sand	0.8 – 1.2
in the enriched quartz sand	0.42 – 0.55
Yield for enrichment of quartz sand, %:	
enriched quartz sand, not less than	80
tailings from magnetic separation	to 15
sieved sand	to 5
Operating regime of the enrichment section, h/day	16

Over 60 months of operation there were five failures of the drums and magnetic separators of the LMO-5000-2, 2003 for two reasons: 1) breakdown of the integrity of the shell of the separator drum by a random magnetic object, for example, a part of an electrode which got into the power supply of the separator; 2) demagnetization of the magnetic system of the drum by hot sand during accidental failure of the water-cooling system of the sectional shop (two drums were demagnetized). The installation of a system for monitoring water feeding prevented repetition of the failures which occur for the second reason, and the acquisition of an AF-20 pressurized spout drier for quartz sand made it possible to regulate the temperature of the dried sand (no higher than 70°C) and there was no longer any need to cool the magnetic system of the drums.

Since separators are easily repaired under the conditions of a glass plant, two extra drums to be kept in stock and two extra shells were acquired. In the case of an irregular situa-

Fig. 2. Exterior view of the MDP-1 magnetic holder for glass molds.

tion the serviceability of the failed separator is restored by replacing a drum in stock. Repairs take about 2 h on average. If the integrity of a shell is ruined, the shell is replaced under the conditions of the glass plant and the restored magnetic drum in stock is put into reserve. If the magnetic system of a magnetic drum became demagnetized, the drum in stock was sent to the separator manufacturer for overhauling.

The use of quartz glass with a lower and stable content of iron oxide at the level 0.42 – 0.55% instead of the previously used non-enriched quartz sand with iron content 0.8 – 1.2% made it possible to stabilize the technological processes in making glass and produce green glass containers at the "Smerdomskii steklozavod" JSC. For example,

– the degree of uniformity of the molten glass improved;

– the temperature at the bottom of the glassmaking furnace was stabilized;

– fewer articles were rejected.

In summary, it can be concluded that it is effective to use a proper section equipped with LMO-5000-2, 2003 magnetic separators for magnetic enrichment of quart glass in the sectional shop of the "Smerdomskii steklozavod."

Example 2. Development of a magnetic holder for glass-molds.

It is well known that when glass molds are repaired the intermediate form was be quickly and reliably secured on the grinding equipment to a high degree of accuracy. In world glass-making practice this problem is usually solved by acquiring the model RS7 machines, manufactured by the French company "SONICAM" and equipped with a magnetic glass-mold holder. The quality of the proposed equipment is fine but the price is high.

The section for repairing molds at the "Smerdomskii steklozavod" JSC is equipped with a domestically produced flat surfacing machine which is used for performing repairs. The difficulty of accurately positioning and securing the glass mold made high-quality repairs a long and difficult process. A specialized magnetic holder for glass molds, which is suitable for installation on an existing machine, was not available on the market.

The problem of developing a specialized magnetic holder glass molds for a grinder available at the works was given to specialists at the ITT Group. As a result, the MDP-1 magnetic holder for glass molds was developed, built, and delivered to "Smerdomskii steklozavod" JSC. The properties of this holder are as follows:

– suited for a standard table of any flat grinding machine;

– intermediate mold is quickly and reliably secured to a high degree of accuracy even if there is damage to the surface;

– permits setting for working a glass mold with diameter from 100 to 170 mm;

– intended for molds used in glass-shaping machines of the rotor type and the IS machines used at the "Smerdomskii steklozavod" JSC.

Tests of the MDP-1 magnetic holder of glass molds showed that it is completely suitable. An exterior view of the magnetic holder of glass molds is presented in Fig. 2. The cost of developing and building the MDP-1 specialized magnetic holder for glass molds was repaid by the quality and cost reduction of the repairs of restored glass-molds.

In summary, it has been show that domestic equipment developed domestically can be used effectively at the glassmaking plants in Russia.

REFERENCES

1. N. N. Konev, "Magnetic enrichment of quartz sand. Analysis of the separator operation," *Steklo Keram.*, No. 5, 12 – 17 (2010); N. N. Konev, "Magnetic enrichment of quartz sands. Analysis of the separator operation," *Glass Ceram.*, **67**(5 – 6), 132 – 137 (2010).
2. N. N. Konev, I. P. Salo, Yu. P. Lezhnev, and V. P. El'skii, "Magnetic enrichment of quartz sand for the glass industry," *Steklo Keram.*, No. 2, 21 – 22 (2001); N. N. Konev, I. P. Salo, Yu. P. Lezhnev, and V. P. El'skii, "Magnetic concentration of quartz sand for glass industry," *Glass Ceram.*, **58**(1 – 2), 57 – 59 (2001).
3. N. N. Konev, I. P. Salo, N. F. Mel'nik, and V. N. Gordiichuk, "Magnetic final enrichment of quartz sand for glassmaking plants," *Steklo Keram.*, No. 5, 33 – 34 (2003).